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THE GRASS-FEEDING FROG-HOPPER OR SPITTLE-BUG

By Philip Garman

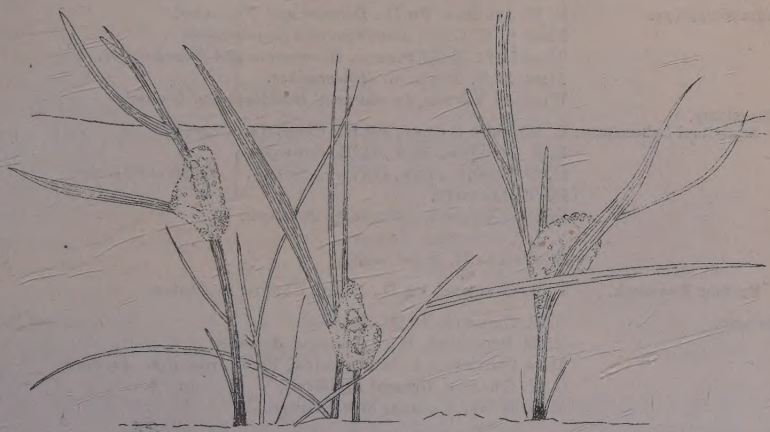

Figure 17. Spittle balls containing nymphs on grass stems

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The Grass-Feeding Frog-Hopper or Spittle-Bug

(*Philaenus lineatus* Linnaeus)

Order *Hemiptera* Family *Cercopidae*

By Philip Garman, Ph.D.

Frog-hopper or spittle-bug balls are often observed on shrubbery or herbaceous plants, in waste or uncultivated fields. Those of the grass-feeding species are especially noticeable in meadows and may cause persons not acquainted with them to speculate—often blindly—concerning their probable nature. Such speculations are mainly confined to the belief in "frog-spit" and "snake-spit," though occasionally we find people who think them the young of grasshoppers. The term "frog-hopper," which has grown out of the unfounded belief that spittle balls are voided by tree-frogs, is not inappropriate when applied to the adult bug because of its squat appearance and hopping ability.

In favorable locations frog-hoppers may become abundant and no doubt do considerable damage. In one instance the writer counted fourteen balls on grass plants within a square foot, which shows the relative abundance of frog-hoppers under some conditions. About New Haven they do not become sufficiently numerous to do serious damage, but they contribute to the sum total of injury caused by leaf-hoppers, grasshoppers and thrips, and may be counted a pest for this reason.

Frog-hoppers are sucking insects which make use of the sap drawn from the plant, to form their protective spittle. Any withdrawal of sap in this way naturally weakens the plant, and the stem upon which the insect has fed may become stunted or may not produce seed.

Orchard grass, timothy, red top and blue grass are infested in Connecticut, while Osborn[5] reports it also from Canada blue grass in Maine. The adults likewise feed on grass shoots but apparently do not do as much damage as the nymphs.

Those who have studied the life histories of American Cercopidae have not reported direct field observation of the egg stage of any of them; nor have they followed these insects through their complete cycle from egg to egg or adult to adult.

Some of the missing links in our chain of information have been observed for the grass-feeding spittle-bug and an effort has been made to follow it through its life cycle by observations in the field, insectary and laboratory. These facts are herein recorded.

History

Osborn[5] studied the species of Maine Cercopidae and his observations are of especial value. He says of the grass-feeding species

In field cages, nymphs hatched about April 20, and the first adults were seen June 14. Insectary temperature during this period varied from 45° - 82° F. The mean hourly temperature during April (April 26 to May 1) was 60.1° F., during May, 57.1° F; and during June (1-14) 60.3° F. For about 60 hours of this period the temperature was below 50° F.

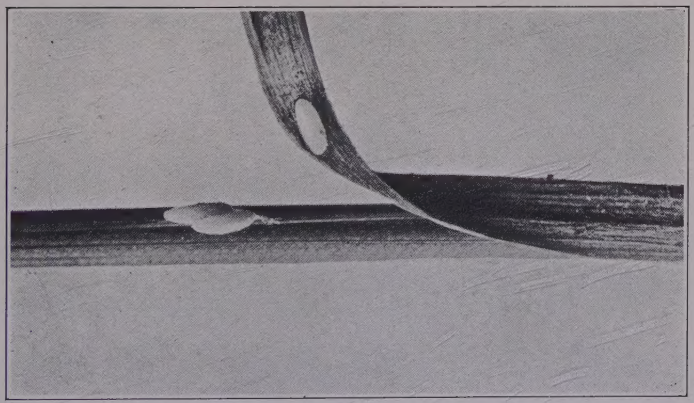
Habits of the Nymph

The newly emerged nymph has a yellow spot on each side of the abdomen. These spots probably mark the location of the spittle glands, the openings of which are on the seventh and eighth segments. While some of the material for the spittle comes from the anal opening, a great part must come from these abdominal glands, the substance flowing beneath the abdomen where it is filled with air bubbles. The apparatus for filling the mass with air bubbles is curious and is connected with a special adaptation for supplying air to the insect itself. In young nymphs the ventral surface of the abdomen is covered with a film of gelatinous material, allowing a space beneath it which connects with the space between the flap-like plates of the terminal segments. Air is drawn beneath this film, the insect keeping the tip of the abdomen above the surface when quiet. Spiracles connecting with air tubes are located on the ventral surface, between pleura and sterna and are covered by the film, in young specimens, and by a series of overlapping plates—extensions of the pleura—in older ones. The insect is enabled in this way to obtain a continual supply of air and at the same time remain submerged in the spittle. When the insect desires to expand the froth it sticks the abdomen above the spittle, encloses an air bubble within the two terminal flaps, brings it beneath the surface and forces it out. Some species, however, are able to work faster. Placing the tip of the abdomen near the surface of the spittle they roll the terminal flaps together rapidly, taking air in and expelling it beneath the surface of the spittle, at the same time moving the tip of the abdomen but little.

Expansion of the froth with air serves to hide the nymph and makes excessive secretion unnecessary. During nymphal life the bug may construct several balls but there is usually little migration after the first mass is formed. Moults take place within the froth and in the case of the grass-feeding frog-hopper, the adult also develops within where it hardens sufficiently to enable it to fly. Thus during nymphal life at least, the grass-feeding spittlebug is protected from predaceous and parasitic enemies and partly from adverse climatic conditions. Lack of moisture seems to prevent development of the younger stages which depend largely on tender rapidly growing shoots as a food supply. The result is seen in their more frequent occurrence in low damp places than in higher well drained pastures.

a. Spittle balls on grass About natural size Photo by Walden.

b. Adult bug. Six times natural size.



c. Eggs on grass. Eight times natural size. Photo by Walden.

PLATE XIX

a. Field with spittle-masses. Photo by Walden.

b. Grass infested with frog-hoppers, showing spittle-masses. Photo by Walden.

Composition of the Froth

Osborn[5] says that the froth mass is only partly soluble in water. This is true since the balls often remain on the stems after showers. The substance is more readily soluble in sodium hydroxide, but is not easily soluble in 80% alcohol. It probably contains some starch or converted sugar, though there is no reaction to iodine. The "albuminous" substance is not coagulated with heat. The material of spittle balls offers an ideal medium for molds and bacteria which may sometimes be found in large numbers.

The Adult

Adults were collected from grass plots near the Station from June 15 to November 9, 1920, and specimens were taken on May 29, 1921, by Mr. Walden. None could be found in the spring of 1921, prior to May 29, in the field where spittle balls and adults were numerous in 1920. None of the adults survived in field cages, although some laid eggs which hatched the following spring. About two dozen adults in a field cage disappeared completely during the summer but laid eggs which hatched about April 20. Another field cage contained two dozen nymphs; all were adult July 4, and they lived in this state until about August 16, when no live individuals could be found. Eggs were laid by these bugs, and recently hatched nymphs were found April 20, 1921.

The adults apparently lay but few eggs. In breeding cages not over one dozen eggs could be obtained from a single female, though it is probable that they may lay more under suitable conditions. Most individuals laid one or two lots of eggs consisting of four or five each, and then died, in spite of efforts to keep them alive and obtain more eggs. Two gravid females collected in the field August 27, contained 4 and 12 well developed eggs respectively, while two others collected in July contained 0 and 4 eggs.

The period elapsing between emergence of the adult and egg laying is about a month. In 1920 adults were obtained in the field June 15 and the first eggs could not be secured until July 12, although attempts were made several times previous to this date. In 1921, with a much more advanced season, freshly emerged adults were taken in the field by Mr. Walden, May 29, and the first eggs were obtained July 6 from confined bugs brought to the insectary. Mating takes place from the first of July until October, at least in this locality.

The length of life of the adult in field cages was about one month and a half, but observations on unconfined specimens indicate a longer period—two to two and one-half months or more. Thus in a grass plot near the Station, no spittle balls were seen after the first of July, yet adults were collected here until November 9.

Eggs were laid in small cages, within two or three days after mating.

The adult bug is comparatively sluggish most of the time. It remains on the stems of grass plants, and is not easily disturbed. If poked with a stick it moves leisurely up or down but never rapidly. If it receives a more violent poke or blow it responds with a tremendous hop, landing a foot or more away from the original position. If followed, it will usually be found lying feet upwards on the ground or head downwards in the grass, and a second blow will fail to react on it until it has had time to regain its feet. The bugs are most active towards evening, lying almost inactive during the morning.

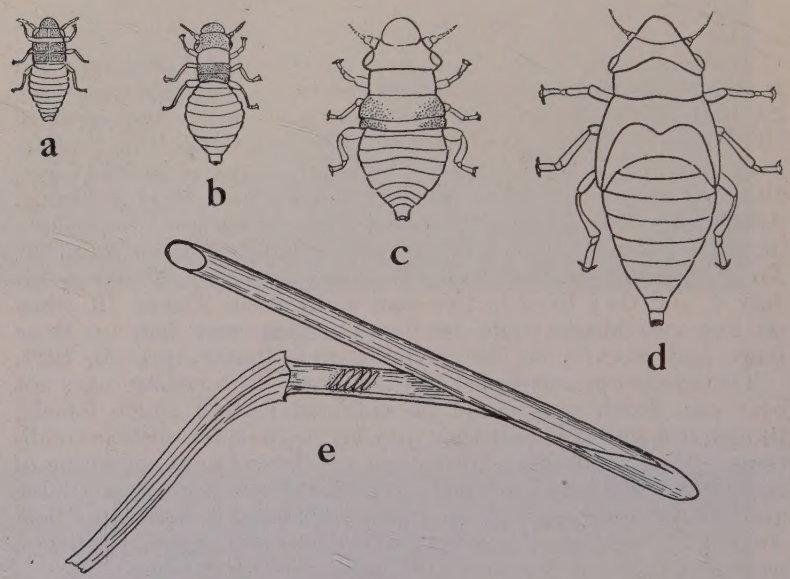


Figure 18. The egg and the nymphal instars of the grass-feeding spittle-bug. a. First instar. b. Second instar. c. Third instar. d. Fourth instar. e. Diagram showing the usual position of the egg.

Description of the Different Stages

Egg (Fig. 18; Pl. XVIII, c.)—The egg is elongate, slightly curved and flattened a little and is usually embedded in a whitish adhesive substance. The surface is smooth. When first laid it is nearly white, but turns light brown with age. There is often a yellowish tint at one end.

Total length about .75-1 mm.

First Instar (Fig. 18, a.)—This stage has the head and thorax and also the legs, dark brown. The abdomen is yellowish white with a darker yellow spot on each side below. The antennae consist of two distinct divisions, the distal division having a number of indistinct annuli. The proximal division has two indefinite segments.

Length of alcoholic specimens 1.2–1.5 mm.

Second Instar (Fig. 18, b.)—This instar is similar in nearly all respects to the first instar except that the prothorax now lacks brown pigment.

The antennae are a little more plainly divided into segments but the two main divisions are still evident. The yellow spots of the abdomen are smaller.

Length of alcoholic specimens 2-3 mm.

Third Instar (Fig. 18, c)—During this stage the abdominal yellow spots disappear, the head loses its brown color, and the wing pads are much more developed. The antennal segments may now be counted with ease.

Length of alcoholic specimens 3.5-4.5 mm.

Fourth Instar (Fig. 18, d)—This stage lacks the brown color of the thorax and head, the entire insect being pale. Antennae are well developed, distinctly segmented and not separated into two divisions as in the first and second instar. The wing pads are well developed, now extending to the caudal margin of the first abdominal segment, and the sexes are easily distinguished with the aid of a microscope.

Length (alcoholic specimens) 5 mm.

Adult, male (Pl. XVIII, b)—Color brown with a pale stripe along each side on the costal margins of the elytra. Head brown, eyes black, the front below marked with arcuate black lines; lora dark brown or black. Venter of thorax and abdomen, and also the tarsal claws black. There is usually a darker stripe on each elytron above the pale costal stripe. The hind legs in common with other spittle-bugs have the tibiae and first two tarsal segments greatly expanded at their tips and spinose.

Length 4.5-5.5 mm; width of head across the eyes 1.5–1.8 mm; greatest width across the elytra when folded 1.8–2 mm.

Female —Similar to the male but slightly larger and the elytra less definitely marked. The meso and metathorax and caudal half of the abdomen below are pale in color.

Length 5–6 mm.

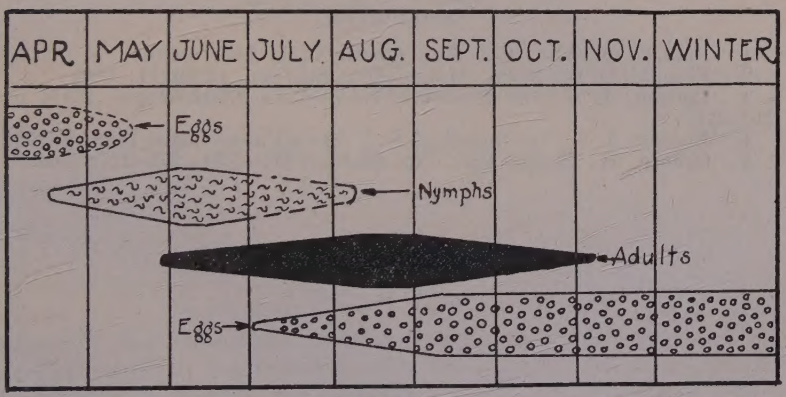


Figure 19. Diagram showing the length of the various stages in the life history.

Control Measures

Osborn suggests control measures for the grass-feeding spittle-bugs, which seem ample. Rotation of crops, or burning over grass land in the fall, winter or early spring should be effective. Hopper-dozer control would probably remove many of the adults but the latter are sluggish and it is doubtful whether the method would

capture a large per cent. Mowing in spring and fall unless very close to the ground and the grass raked off soon after, would also be ineffective because of the position of the eggs. If the grass is allowed to lie on the ground the nymphs will soon crawl from the cut grass to fresh stems.

Spraying is too costly an operation to be of much use in practical control work. Dusting might be done effectively under some conditions though it is well nigh impossible to get action from any insecticides owing to the protective spittle.

Summary

1. The grass-feeding frog-hopper may cause considerable damage to grasses in meadows.

2. The life cycle lasts a year, the greater part of which is passed as an egg laid during the summer and fall.

3. The eggs are laid between a leaf and a stem, being usually placed 4 or 5 together, and within two or three inches of the ground.

4. The adults are found in the field from June until frost, laying eggs over a considerable period (July-October).

5. The nymph passes through four stages, and lives about a month and a half. Nymphs hatched in 1921 about April 20.

6. Control measures should consist of burning over the land during fall, winter, or early spring.

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Note:—This bulletin properly belongs in the report for 1921, but owing to delay in issuing the report for 1920, it is here included to secure its earlier publication.